Title of Document:

Reporting Data with "Over-the-Counter" Data Analysis Supports Improves Educators' Data Analyses

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Date of Publication:

March, 2014

Conference Organization:

Society for Information Technology & Teacher Education (SITE)

Conference Title:

Society for Information Technology & Teacher Education (SITE) International Conference

Conference Location: Jacksonville, Florida

Conference Dates: March 17-21, 2014

The subsequent pages comprise the complete presentation paper as it was submitted, accepted, and presented.

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Abstract: The benefits of making data-informed decisions to improve learning rely on educators correctly interpreting given data. Many educators routinely misinterpret data, even at districts with proactive support for data use. The tool most educators use for data analyses, which is an information technology data system or its reports, typically reports data *without* guidance concerning the data's proper analysis. A solution to data misinterpretation lies in applying medical labeling conventions to information technology to essentially offer educators *over-the-counter* data, meaning reports are paired with straightforward verbiage on the proper interpretation of contents. Findings from a quantitative study involving 211 educators of varied backgrounds and roles at nine schools throughout California included improvements to respondents' data analysis accuracy by 205%-436% when one of varied forms of data analysis guidance was embedded within the information technology reporting environment. Findings were significant and can be used to improve data systems and data use.

Introduction and Theoretical Framework

Over-the-counter medication is deemed negligent if not accompanied by textual guidance proven to improve its use (DeWalt 2010). No or poor medication labels have resulted in many errors and tragedy, as people are left with no way to know how to use the contents wisely (Brown-Brumfield & DeLeon 2010). Labeling conventions such as those used for over-the-counter medication can translate to improved understanding and use of non-medication products, as well (Hampton 2007; Qin et al. 2011).

Thus, in the way over-the-counter medicine's proper use is communicated with a thorough label and added documentation, an information technology system used to generate student data can include components to help users better comprehend the data it contains. Yet such data systems currently display data for educators without sufficient support to use their contents – data – wisely (Coburn, Honig, & Stein 2009; Data Quality Campaign [DQC] 2009, 2011; Goodman & Hambleton 2004; National Forum on Education Statistics 2011).

A *data system* is a computer system meant to provide educators with student data to help solve educational problems (Wayman, 2005). Examples of data systems include student information systems (SISs), assessment systems, instructional management systems (IMSs), and data-warehousing systems, but distinctions between different types of data systems are blurring as these separate information technology systems begin to serve more of the same functions (Bill and Melinda Gates Foundation, 2007).

Labeling and tools within data systems to assist analyses are uncommon, even though most educators analyze data while unaccompanied by someone who can help them use the data appropriately (U.S. Department of Education Office of Planning, Evaluation and Policy Development [USDEOPEPD] 2009). Essentially, data systems do not commonly present data in an "over-the-counter" format that offers educators guidance in the report contents' use. For educators, whose primary purpose for using data is to treat students, using data without embedded support is akin to using medicine from an unmarked or marginally marked container. This study considered the impact on educators' data analyses if data systems provided data in an *over-the-counter* format, meaning data usage guidance was embedded within the reporting environment.

Problem

Educators make data analysis errors impacting students, yet data systems do not include analysis help, and it was undecided whether adding supports to data systems can reduce the number of analysis errors. Data-informed decisions can lead to improved learning (Sabbah 2011; Underwood, Zapata-Rivera, & VanWinkle 2010; Wohlstetter, Datnow, & Park 2008). Most educators have access to data systems to generate and analyze score reports (Aarons 2009; Herbert 2011). Educators worldwide are expected to use these reports to make decisions that impact student learning (Hattie & Brown 2008).

Unfortunately, educators do not use this data correctly, and there is evidence many users of data system reports have trouble understanding the data (Hattie 2010; National Research Council 2001; Wayman, Snodgrass Rangel, Jimerson, & Cho 2010; Zwick et al. 2008). For example, in two national studies of districts known for *strong* data use, teachers' accuracy when interpreting data was only 48% correct and it is unlikely other school districts would perform any better (USDEOPEPD, 2009, 2011).

Few teacher preparation programs cover topics like assessment data literacy (Halpin & Cauthen 2011), most people analyzing data received *no* training to do so (DQC 2009; Few 2008), and human biases compromise judgment and complicate decision-making processes (Kahneman 2011). Even when professional development and added staffing are employed to improve data use, these supports require added resources and – though generally beneficial – are not foolproof. For example, in a study where teachers received PD in measurement, all teachers struggled afterwards with statistical terms and measurement concepts (Zapata-Rivera & VanWinkle, 2010). Also, knowledge management research indicated knowledge is hard to share with others, even when the intention to share it is there, especially when power or status is involved (Cho & Wayman, 2009).

Data use impacts students, and misunderstandings when using data systems can cripple data use in school districts (Wayman, Cho, & Shaw 2009). Yet labeling and tools within data systems to assist analysis are uncommon, even though most educators analyze data alone (USDEOPEPD 2009). There is a clear need for research identifying how reports can better facilitate correct interpretations by its users (Goodman & Hambleton 2004; Hattie 2010). The power of data systems that generate these reports will not be realized until researchers contribute to improving data system design to improve analysis (DQC 2011).

Methods and Purpose

The purpose of the experimental, quantitative study was to facilitate causal inferences concerning the degree to which including different forms of data usage guidance within a data system reporting environment can improve educators' understanding of the data contents, much like including different forms of usage guidance with over-the-counter medication is needed to improve use of contents. The study's primary independent variables included the following types of data analysis guidance, each of which was framed in two different formats and was used with two reports per study participant to answer four data analysis-based questions of varied complexity:

- **Footer**: A report footer is a brief set of text at the bottom of a report that communicates information an educator would need to know to correctly understand and analyze that particular report's data. The study's footers ranged from 34-58 words, 156-269 characters without spaces, and 224-324 characters with spaces. Footers were either monochromatic or contained minimal color used purposefully; for example, "Warning" was featured in red and "What to Do" was featured in green.

- **Reference Sheet**: A report-specific reference sheets, also called an abstract, is a single page that accompanies a report to help the educator more easily understand the report and analyze its data. The study's reference sheets contained the report's title, description, image, focus (content reported), and warning (vital, cautionary information an educator would need to avoid the most common analysis errors made when analyzing the particular data being displayed). Half of the study's sheets also communicated the report's purpose (key questions the report will help answer) and additional focus information (intended audience, and format in which data is reported).

- **Reference Guide**: A reference guide, also called an interpretation guide, is a 2- or 3-page reference guide that accompanies a report to help the educator more easily use the report and analyze its data. The study's guides adhered to either of two formats: (a) the report's reference sheet (as described above) functioned as the guide's 1st page, and pages followed containing the report's instructions (how to read the report), essential questions (showing the user where to look on this report – and what to look for – to answer each question listed in the purpose area of the guide's 1st page), and a "more info" section (offering where to get additional information on related topics); or (b) the guide contained the

report's title, description, warning, essential questions, and a "more info" section (details for these sections was provided earlier in article).

The dependent variable was accuracy of data analysis-based responses, measured by a survey containing data analysis questions. 211 elementary and secondary educators throughout California answered these questions while viewing one of seven report sets of student data (Fig. 1-7).

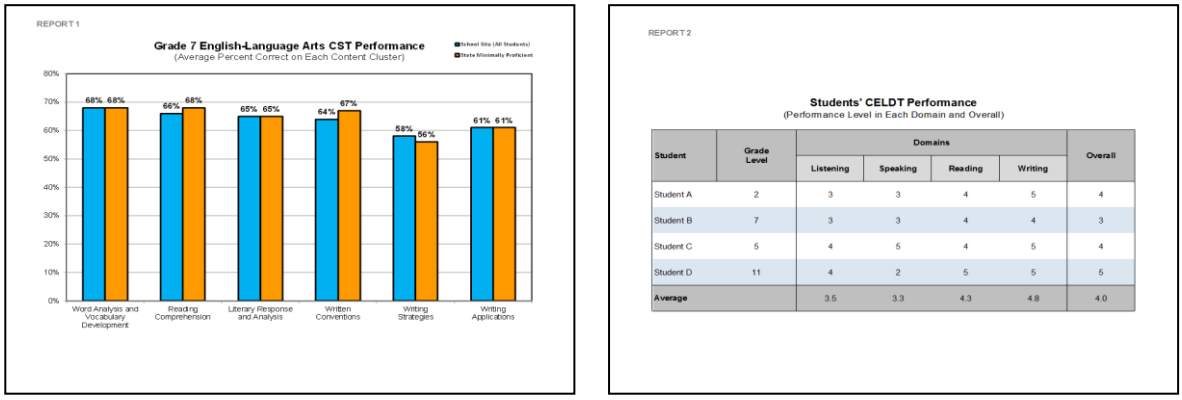

Figure 1: *Scenario 1 Participant (Control Group) Handouts; No Supports Were Received*

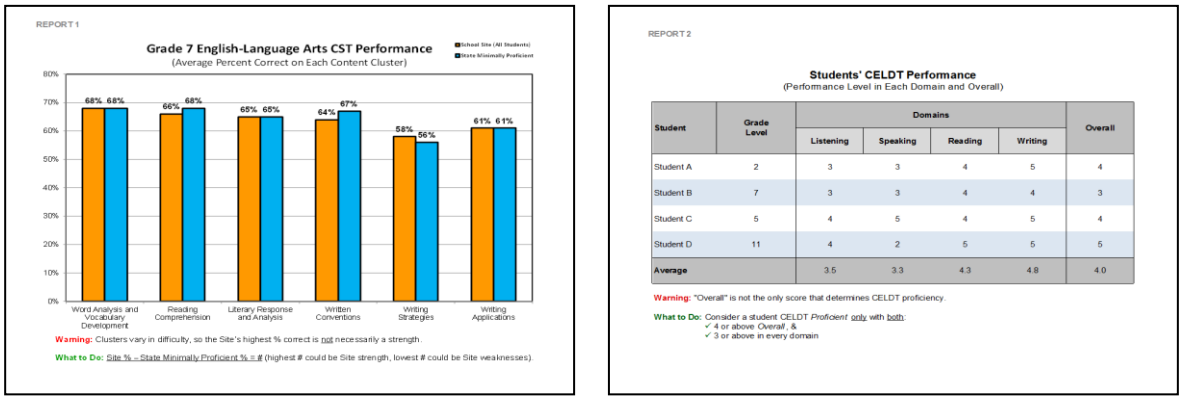

Figure 2: *Scenario 2 (Footer A) Participant Handouts; Note Footer/Support at Bottom of Page*

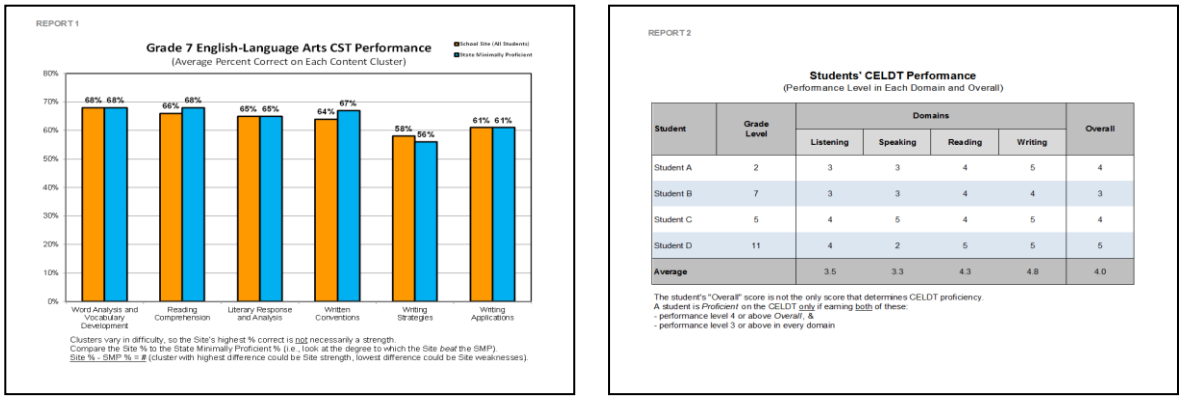

Figure 3: *Scenario 3 (Footer B) Participant Handouts; Note Footer/Support at Bottom of Page*

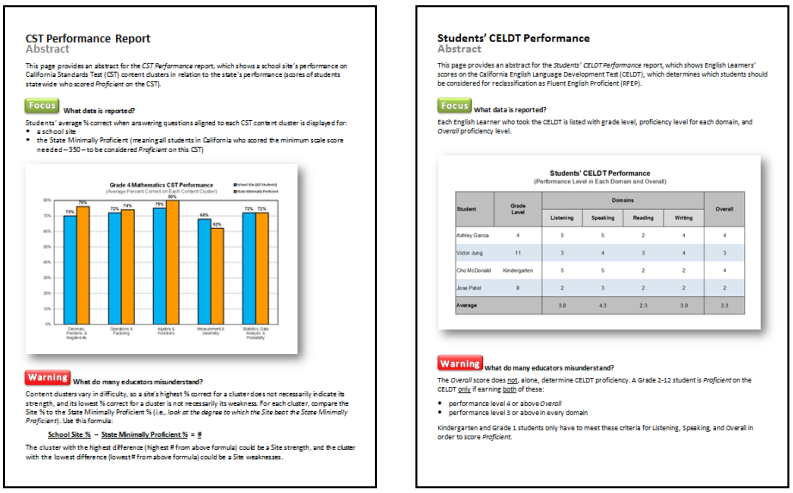

Figure 4: *Scenario 4 Participant (Reference Sheet A) Handouts; Participants Also Received Figure 1 Handouts*

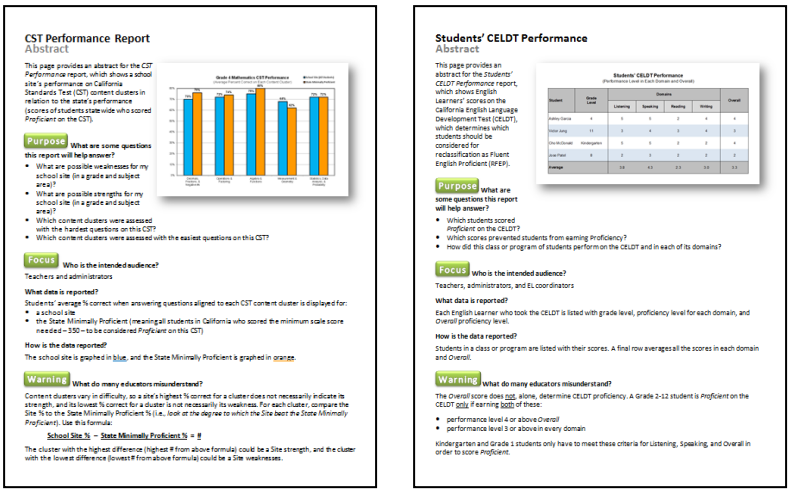

Figure 5: *Scenario 5 Participant (Reference Sheet B) Handouts; Participants Also Received Figure 1 Handouts*

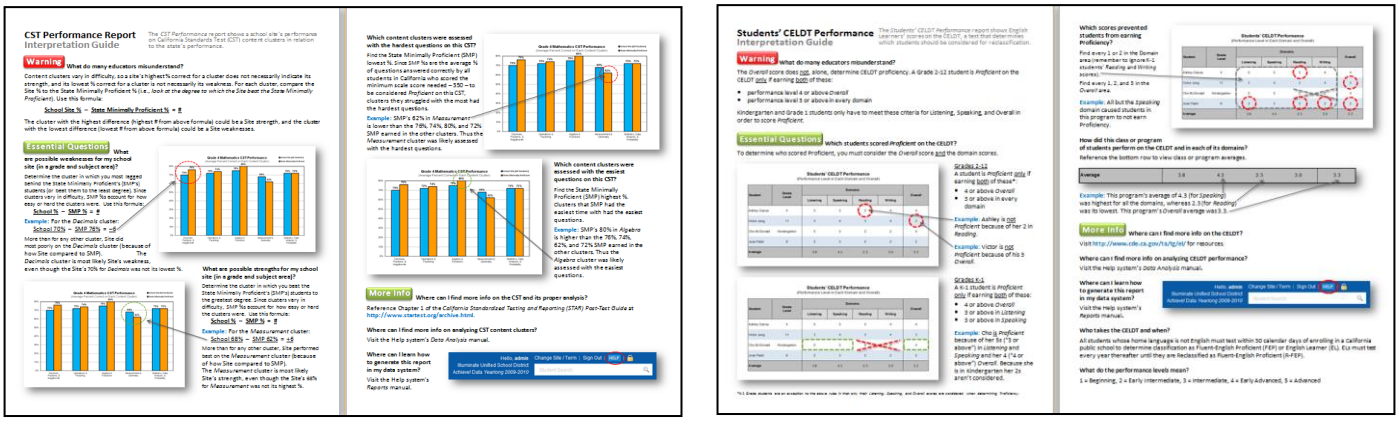

Figure 6: *Scenario 6 Participant (Reference Guide A) Handouts; Participants Also Received Figure 1 Handouts*

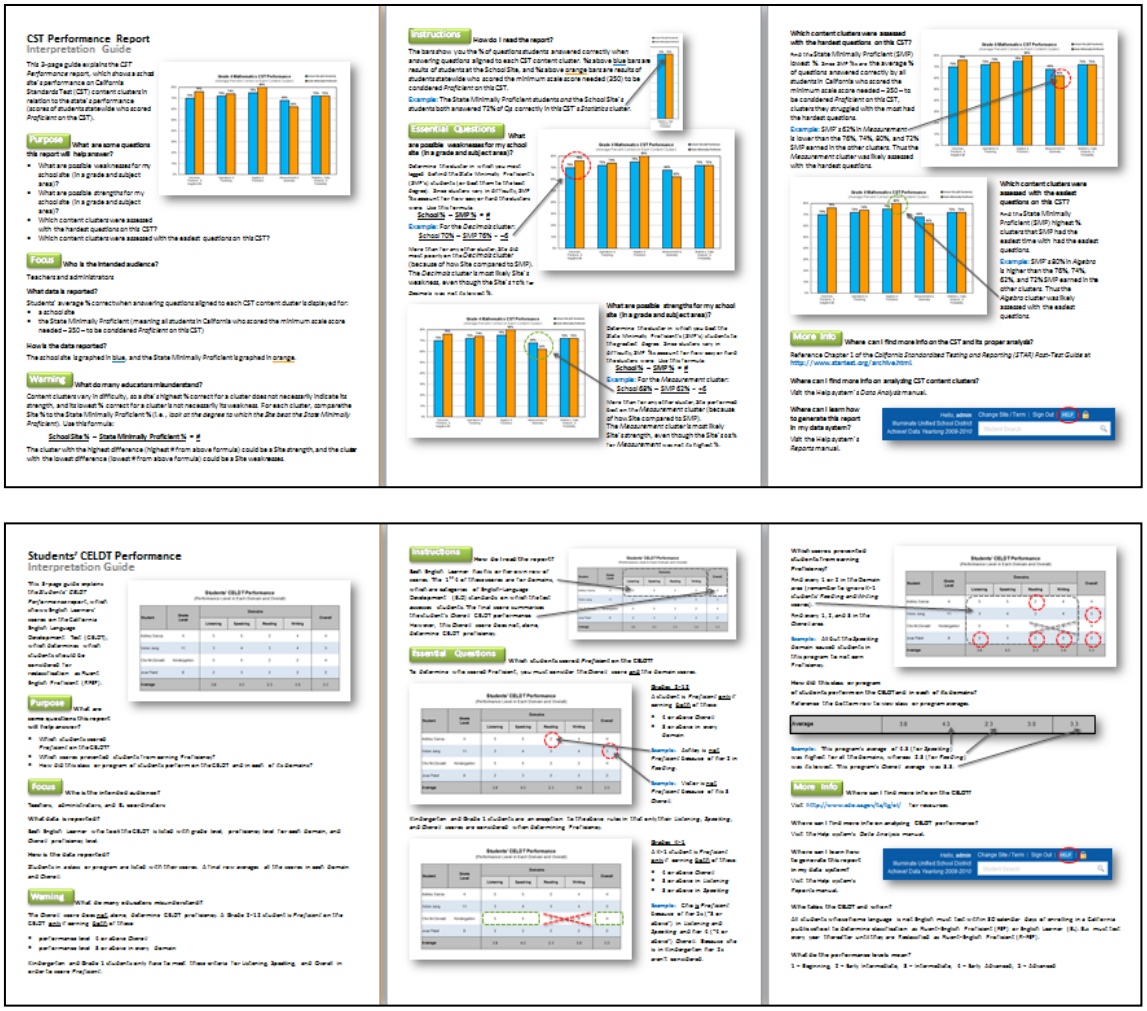

Figure 7: *Scenario 7 Participant (Reference Guide B) Handouts; Participants Also Received* Figure 1 *Handouts*

Findings

All supports used in the study had a significant, positive impact on educators' data analysis accuracy. Educators' data analyses were:

- 307% more accurate (with a 23 percentage point difference) when a footer was present and 336% more accurate (with a 26 percentage point difference) when respondents specifically indicated having used the footer,

- 205% more accurate (with a 12 percentage point difference) when a reference sheet was present and 300% more accurate (with a 22 percentage point difference) when respondents specifically indicated having used the reference sheet,

- 273% more accurate (with a 19 percentage point difference) when an
- reference guide was present and 436% more accurate (with a 37 percentage point difference) when respondents specifically indicated having used the guide, and

- 264% more accurate (with an 18 percentage point difference) when any one of the three supports was present and 355% more accurate (with a 28 percentage point difference) when respondents specifically indicated having used the support.

On average, the 211 study participants indicated they used supports 58% of the time:

- Respondents receiving footers indicated they used them 73% of the time, on average.
- Respondents receiving reference sheets indicated they used them 50% of the time, on average.
- Respondents receiving reference sheets indicated they used them 52% of the time, on average.

87% of participants who receive no supports indicated they would have used footers, reference sheets, or reference guides if the supports had been available.

When no supports were used, data analysis accuracy was 11%. All 211 participants, regardless of support use, averaged a data analysis accuracy of 26%. In cases where respondents indicated they used an available support, data analysis accuracy was 39%. See Fig. 8 for visual representation.

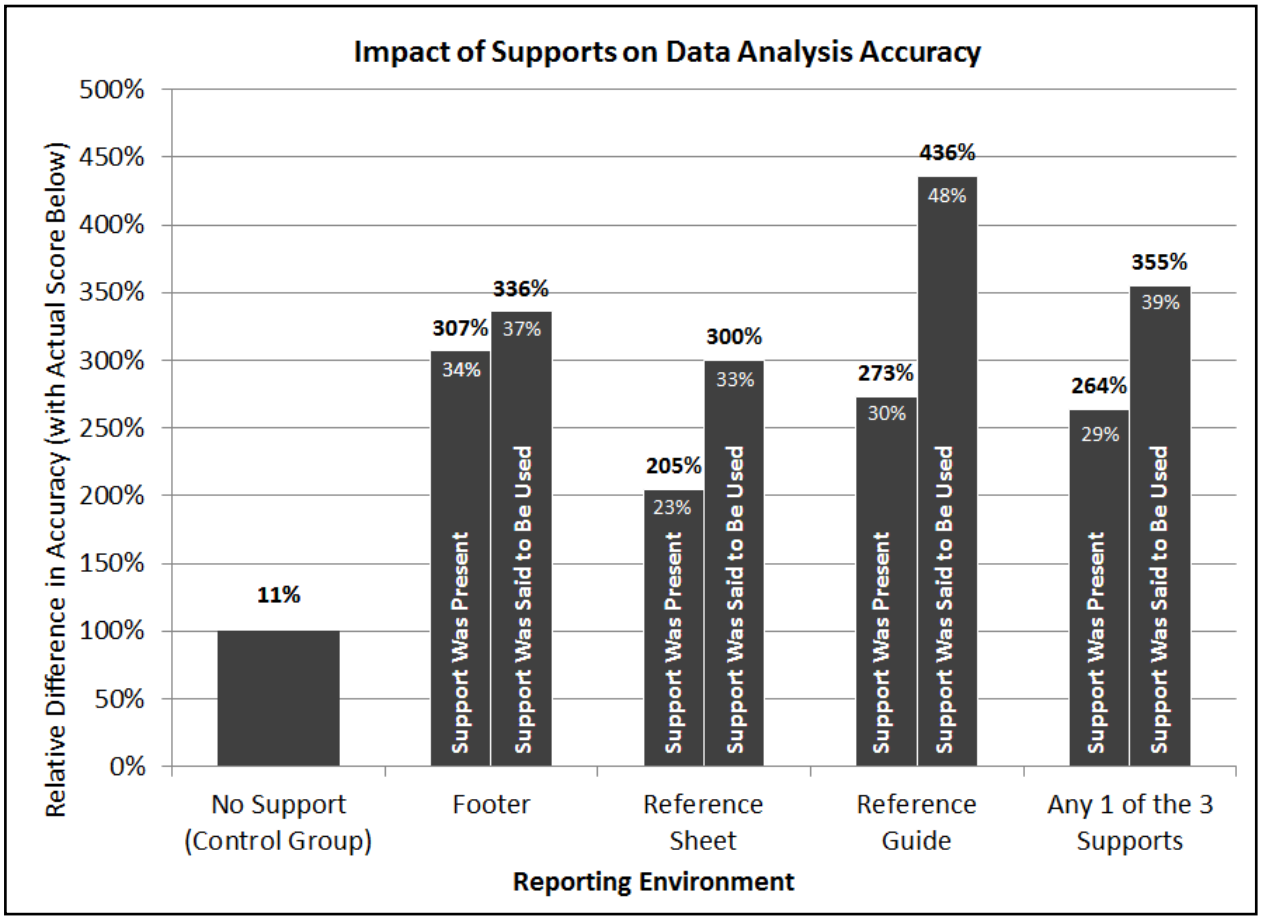

Figure 8: *Impact of Supports in Terms of Relative Difference*

Significance

The findings of this study filled a gap in education field literature by containing evidence that can be used to identify how data systems can help increase educators' data analysis accuracy by providing analysis support directly within the information technology and its reports. The study also rendered examples and templates for real-world implementation, which are available for free, open access, on the researcher's website. Improvements data system and report providers make in light of this study have potential to improve the accuracy with which educators analyze the data generated by their data systems. This improvement will likely benefit students impacted by educators' data-informed decision-making.

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Acknowledgements

Sincere thanks and respect go to the 211 educators who participated in this study, as well as to all who graciously helped to make the necessary arrangements. Since this study's findings are intended to be used to improve the manner in which information technology communicates data to educators so as to better assist them in helping students, this generous gift of time constitutes yet one more way in which participants give selflessly for kids. Our future is a bright vision when such champions for students are in our schools.